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Mark Scheme (Results)
January 2011

GCE

GCE Decision Mathematics D1 (6689/01)

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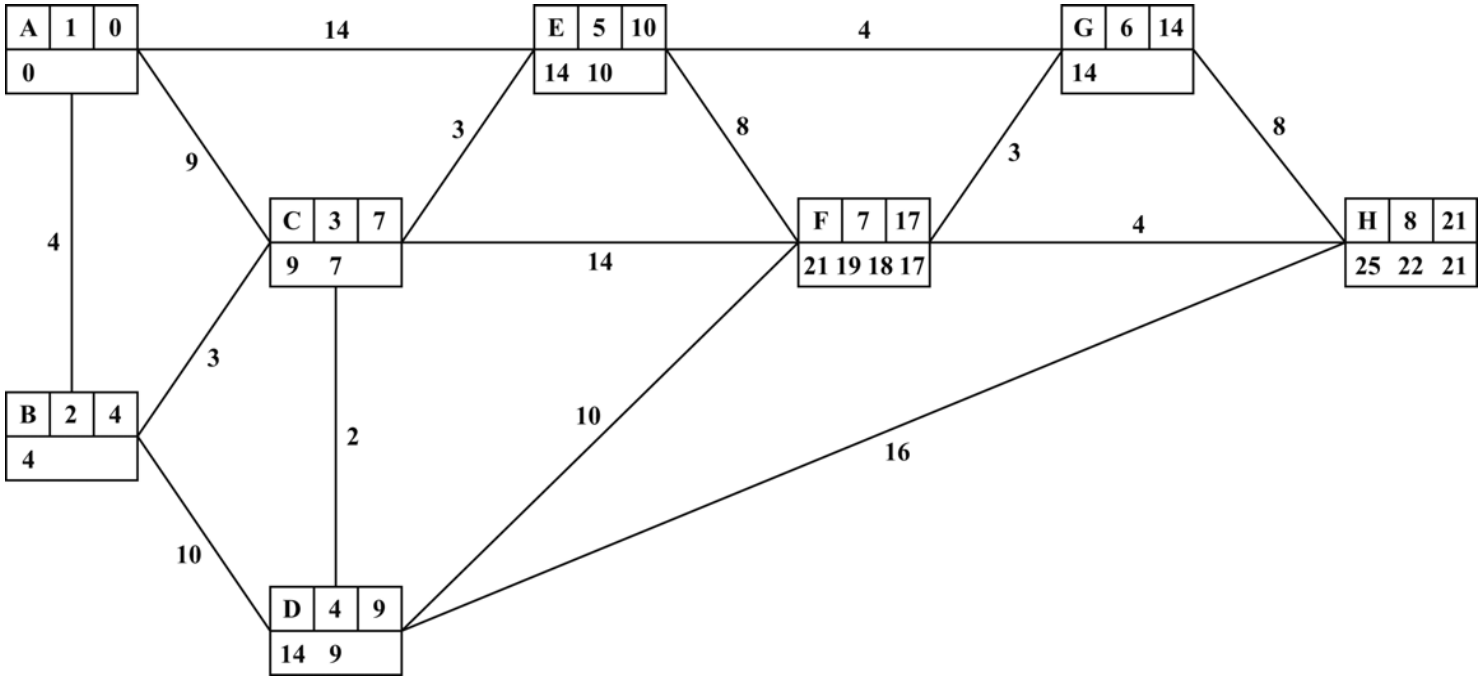
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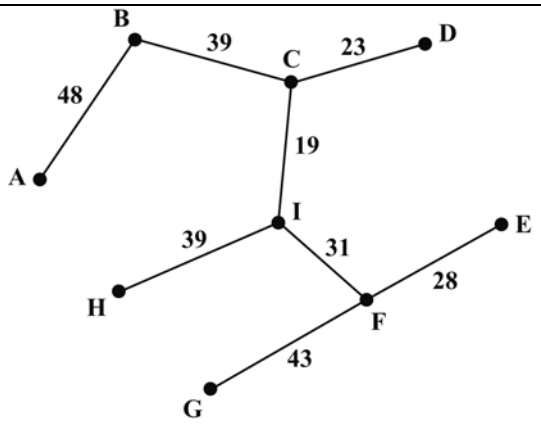
January 2011
Decision Mathematics D1 6689
Mark Scheme

Question Number	Scheme	Marks
1. (a)	 The length of the shortest route is 21 miles	M1 A1 A1ft A1 A1ft (5)

Question Number	Scheme	Marks
(b)	Shortest route: A B C E G F H	B1 (1)
(c)	Shortest route: H F G E C Length of shortest route: 21 – 7 = 14 miles	B1ft B1ft (2) **[8]**
	Notes	
(a)	1M1: Smaller number replacing larger number in the working values at C or D or G or E or F or H. (generous – give bod) 1A1: All values in boxes A, B and C correct. (Condone missing wv at A) (Allow order of labelling starting at 0) 2A1ft: All values in boxes D, E and G (ft) correct . Penalise order of labelling errors just once, G must be labelled before F. 3A1: All values in boxes F and H correct 4A1ft: Follow through from their H value, condone lack of units here.	
(b)	1B1: CAO (either way round)	
(c)	1B1ft: only ft if their shortest route goes through C, in which case accept their route reversed up to C (either way round) 2B1ft: only ft if their shortest route goes through C, in which case accept their route length (or final value at H) -7.	

<table>
<tr><th>Question Number</th><th>Scheme</th><th>Marks</th></tr>
<tr><td>2.
(a)</td><td>Lower bound = $\frac{173}{50} = 3.46$ so 4 bins</td><td>B1 B1
(2)</td></tr>
<tr><td>(b)</td><td>Bin 1: 23 + 11 + 10   Bin 4: 35
Bin 2: 29 + 14   Bin 5: 17
Bin 3: 34</td><td>M1 A1
A1
(3)</td></tr>
<tr><td>(c)</td><td>e.g.
<table><tr><td>23</td><td>29</td><td>11</td><td>34</td><td>10</td><td>14</td><td>35</td><td>17</td></tr><tr><td>29</td><td>23</td><td>34</td><td>11</td><td>14</td><td>35</td><td>17</td><td>10</td></tr><tr><td>29</td><td>34</td><td>23</td><td>14</td><td>35</td><td>17</td><td>11</td><td>10</td></tr><tr><td>34</td><td>29</td><td>23</td><td>35</td><td>17</td><td>14</td><td>11</td><td>10</td></tr><tr><td>34</td><td>29</td><td>35</td><td>23</td><td>17</td><td>14</td><td>11</td><td>10</td></tr><tr><td>34</td><td>35</td><td>29</td><td>23</td><td>17</td><td>14</td><td>11</td><td>10</td></tr><tr><td>35</td><td>34</td><td>29</td><td>23</td><td>17</td><td>14</td><td>11</td><td>10</td></tr></table>List sorted - no more changes</td><td>M1
A1
A1ft
A1cso
(4)</td></tr>
<tr><td>(d)</td><td>Bin 1: 35 + 14   Bin 3: 29 + 17
Bin 2: 34 + 11   Bin 4: 23 + 10</td><td>M1 A1
A1cso
(3)
[12]</td></tr>
<tr><td>Alt (c)</td><td><table><tr><td>23</td><td>29</td><td>11</td><td>34</td><td>10</td><td>14</td><td>35</td><td>17</td><td></td></tr><tr><td>35</td><td>23</td><td>29</td><td>11</td><td>34</td><td>10</td><td>14</td><td>17</td><td></td></tr><tr><td>35</td><td>34</td><td>23</td><td>29</td><td>11</td><td>17</td><td>10</td><td>14</td><td>A1</td></tr><tr><td>35</td><td>34</td><td>29</td><td>23</td><td>17</td><td>11</td><td>14</td><td>10</td><td></td></tr><tr><td>35</td><td>34</td><td>29</td><td>23</td><td>17</td><td>14</td><td>11</td><td>10</td><td>A1ft</td></tr></table></td><td></td></tr>
</table>

Question Number	Scheme	Marks
	Notes	
(a)	1M1= 1B1: Cao 4 1A1= 2B1: either $(173 \pm 20) \div 50$ or 3<answer<4 seen.	
(b)	1M1: First four items placed correctly and at least 6 values put in bins 1A1: Bin 1 correct (condone cumulative totals) 2A1: All correct (condone cumulative totals)	
(c)	1M1: Bubble sort, one pass complete end term 35 or 10, consistent direction. 1A1: First two passes correct 2A1ft: Next two passes correct 3A1: cso + 'final' or re-listing etc.	
(d)	1M1: Bin 3 correct and at least 6 values put in bins 1A1: two bins correct (condone cumulative totals) 2A1: cso (condone cumulative totals)	
Misread for Q2(c)	**Sorting into ascending order** **If list reversed into descending order at end, allow full marks**	
	(i) Left to right 23 29 11 34 10 14 35 17 23 11 29 10 14 34 17 35 11 23 10 14 29 17 34 35 A1 11 10 14 23 17 29 34 35 10 11 14 17 23 29 34 35 A1ft List in order	
	(ii) right to left 23 29 11 34 10 14 35 17 10 23 29 11 34 14 17 35 10 11 23 29 14 34 17 35 A1 10 11 14 23 29 17 34 35 10 11 14 17 23 29 34 35 A1ft List in order If list not reversed remove last 2A if earned **Numbers changing during the course of the sort** • If the number change does not alter the sort (e.g. 23 becomes 25) remove final A only. If persists in (d) but does not affect answer similarly remove final A only in (d). • If the number alters the sort (e.g 23 becomes 32) mark as a misread in (c) and if persists in (d) mark (c) and (d) together as a misread – so just take 2 marks off in total for these two sections.	

Question Number	Scheme	Marks
3. **(a)**	CI CD (not DI) EF FI (not EI not DE) $\left\{\begin{matrix}\text{BC}\\\text{HI}\end{matrix}\right\}$ (not BI) GF (not GI not HG) AB	M1 A1 A1 (3)
(b)	AB BC CI CD FI EF IH FG	M1 A1 A1 (3)
(c)	 Weight: 270	B1 B1 (2)
(d)	Start off the tree with DI and HG and then apply Kruskal's algorithm	B2,1, 0 (2) **[10]**
	Notes	
(a)	1M1: Kruskal's algorithm – first 4 arcs selected chosen correctly. 1A1: All eight non-rejected arcs chosen correctly.(Working seen in (a)) 2A1: All rejections correct and in correct order and at correct time.	
(b)	1M1: Prim's algorithm – first four arcs chosen correctly, in order, or first five nodes chosen correctly, in order.{A, B,C,I, D} (arcs not arc lengths) 1A1: First six arcs chosen correctly; all 9 nodes chosen correctly, in order.{A,B,C,I,D,F,E,H,G}[1 2 3 5 7 6 9 8 4] 2A1: cso	
(c)	1B1: cao (condone lack of numbers) 2B1: 270 cao	
(d)	1B1: Kruskal's algorithm + some argument 2B1: Kruskal's algorithm + start with the two arcs. (o.e)	

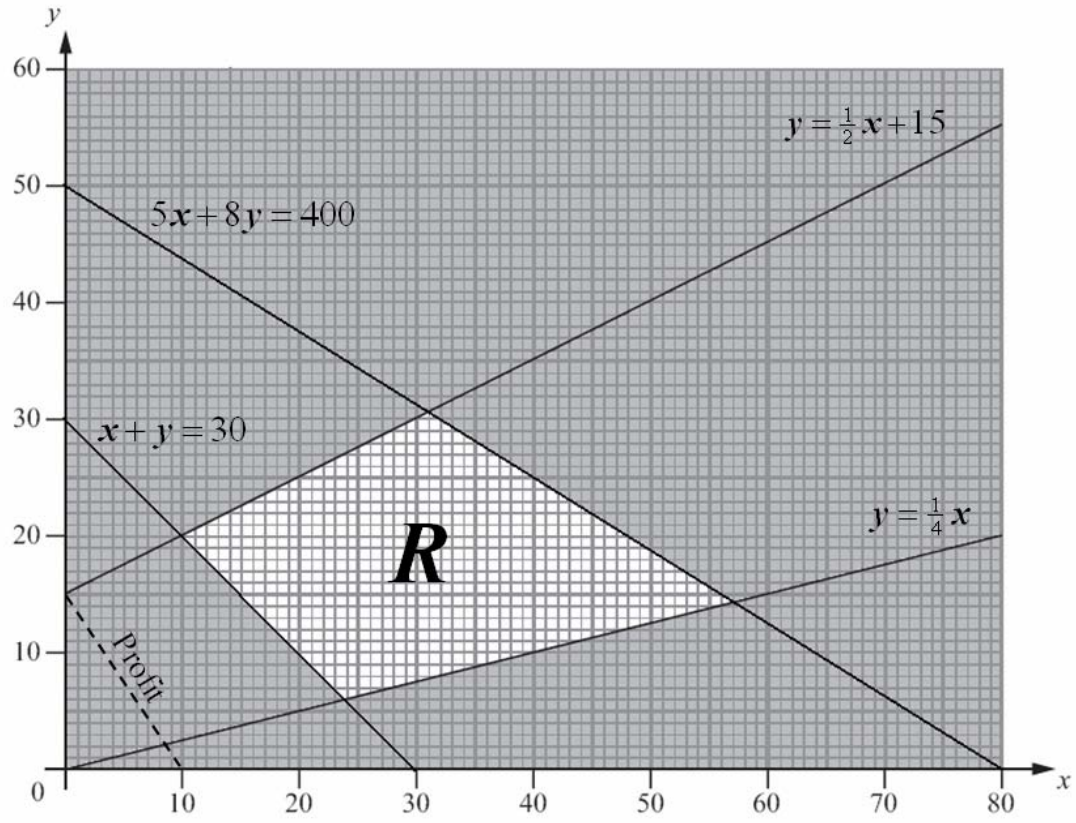
Question Number	Scheme	Marks
4.		
(a)	Bipartite graph	B1
(b)	e.g. J – 3 = B – 6 = K – 1 Change status J = 3 – B = 6 – K = 1 A = 2 B = 6 (D unmatched) J = 3 K = 1 M = 5	 M1 A1 A1 (3)
(c)	e.g. D – 2 = A – 6 = B – 1 = K – 4 Change status D = 2 – A = 6 – B = 1 – K = 4 A = 6 B = 1 D = 2 J = 3 K = 4 M = 5	 M1 A1 A1 (3) **[7]**
	Notes:	
(a)	1B1: Cao, but be charitable on spelling, award if phonetically close.	
(b)	1M1: Path from J to 1 or 4 (or vice versa) 1A1: CAO including change status (stated or shown), chosen path clear. 2A1: CAO must ft from stated path, diagram ok	
(c)	1M1: Path from D to 4 or 1 (or vice versa) 1A1: CAO including change status (stated or shown),but only penalise once per question, chosen path clear. 2A1: CAO must ft from stated paths, diagram ok. Must have both M's.	
Alternative answers: **(b)**		

Path	A B D J K M
J – 3 – B – 1	2 1 – 3 6 5
J – 3 – B – 6 – K – 1	2 6 – 3 1 5
J – 3 – B – 6 – K – 4	2 6 – 3 4 5

(c)

Path	A B D J K M
D – 2 – A – 6 – K – 4 D – 5 – M – 2 – A – 6 – K – 4	6 1 2 3 4 5 6 1 5 3 4 2
D – 2 – A – 6 – B – 1 – K – 4 D–5–M– 2 – A – 6 – B – 1– K – 4	6 1 2 3 4 5 6 1 5 3 4 2
D – 2 – A – 6 – B – 1 D – 5 – M – 2 – A – 6 – B – 1	6 1 2 3 4 5 6 1 5 3 4 2

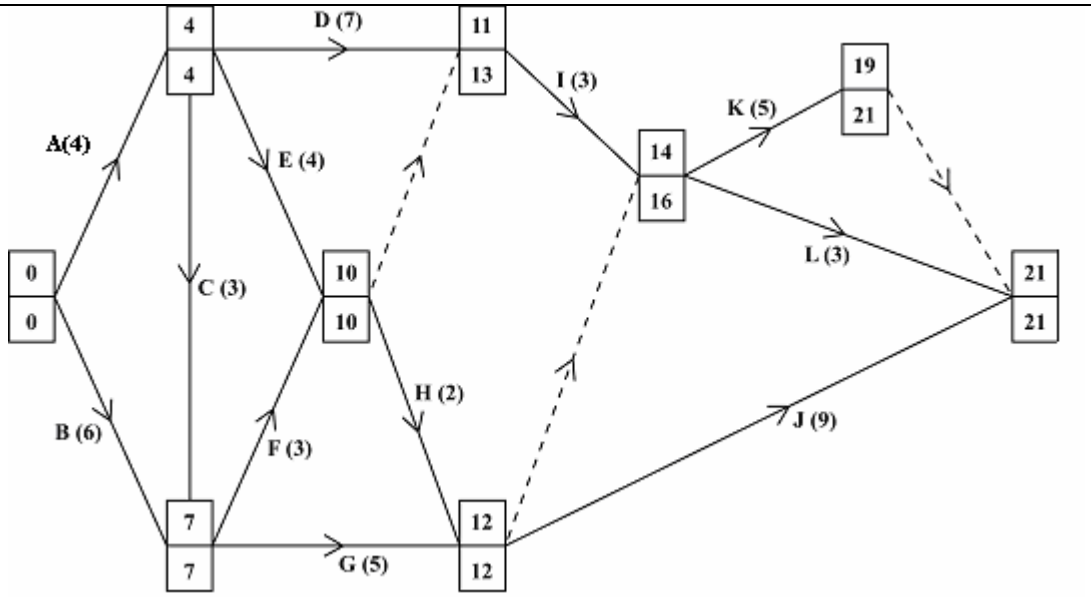
Question Number	Scheme	Marks
5.		
(a)	AD + FI = 4.5 + 5.3 = 9.8 AF + DI = 5.8 + 3.9 = 9.7 smallest AI + DF = 5.9 + 5.1 = 11.0 e.g. ABDGIGDEIHFEACFEA	M1 A1 A1 A1 A1 (5)
(b)	Roads AE, EF (or AEF), DG and GI (or DGI) should be repeated. Length is 31.6 + 9.7 = 41.3 km	B1 M1A1ft
(c)	We now only have to repeat one pair of odd vertices, one of which can not be D. (FI = 5.3, AF = 5.8 and AI = 5.9) FI gives the smallest of the three so choose to repeat FI (FHI) The machine should be collected from A.	M1 A1 DA1 (3) **[11]**
	Notes	
(a)	1M1: Three pairings of their four odd nodes 1A1: one row correct 2A1: two rows correct 3A1: all correct 4A1: Any correct route (17 nodes)	
(b)	1B1: correct **arcs** identified 1M1: 31.6 + ft their least, from a choice of at least two. 1A1: ft has correctly their plausible least (from a choice of at least two) to 31.6.	
(c)	1M1: Identifies need to repeat one pairing, not including D (maybe implicit) or listing of potential repeats. 1A1: Identifies FI as least. 2DA1: dependent on their identifying FI as repeat	

Question Number	Scheme	Marks
6.		
(a)	$4y \geq x$ o.e. $2y \leq x + 30$ o.e	B1 B1 B1 B1 (4)
(b)	$x + y = 30$ and $5x + 8y = 400$ added to the graph shading correct R correct	B1, B1 B1ft B1 (4)
(c)	Profit line attempted Correct profit line (10, 20)	M1 A1 B1 (3) **[11]**

Question Number	Scheme	Marks
	Notes	
(a)	1B1: ratio of coefficients correct (i.e. equation of line correct) 2B1: inequality correct way round.($ay \geq bx$ o.e.) 3B1: ratio of coefficients correct (i.e equation of line correct) 4B1: inequality correct way round.	
(b)	1B1: $x + y = 30$ drawn cao 2B1: $5x + 8y = 400$ drawn cao 3B1ft: shading correct or implied from lines with negative gradient. 4B1: cao	
(c)	1M1: Profit line – intersecting both axes. Minimum (2,0) to (0,3). Accept reciprocal gradient here. 1A1: a correct line 2A1=1B1: cao (e.g not '10x + 20y')	

Question Number	Scheme	Marks
7. **(a)**		B3,2,1,0 (3)

Activity	Immediately preceding activities
G	B, C
H	E, F
I	D, E, F
J	G, H
K	G, H, I
L	G, H, I

(b)	Dummy from 6 to 7 needed because K and L depend on G H and I, but J depends on G and H only. Dummy from 8 to 9 needed because no two activities may share both the same start event number and the same finish event number.	B3,2,1,0 (3)
(c)		M1 A1 M1 A1 (4)
(d)	Critical activities: A C $\left\{\begin{matrix}\text{F H}\\ \text{G}\end{matrix}\right\}$ J	B2,1,0 (2)
(e)	Total float on activity K= 21 – 14 – 5 = 2	M1 A1ft (2)
(f)	Lower bound is $\frac{54}{21} = 2.57 = 3$	B1 B1ft (2) **[16]**

Question Number	Scheme	Marks
	Notes	
(a)	1B1: Any two rows correct 2B1: Any 4 rows correct 3B1: all correct	
(b)	1B1: first dummy (precedence) explained, maybe confused, be generous, give bod. 2B1: first dummy clearly explained – all relevant activities referred to. Must refer to K and/or L; H and/or G; I and J 3B1: second dummy (uniqueness) explained, maybe confused, be generous, give bod.	
(c)	1M1: All top boxes completed generally increasing left to right.(Condone one rogue) 1A1: cao. 2M1: All bottom boxes completed generally decreasing right to left. (Condone one rogue) 2A1: cao.	
(d)	1B1: Critical activities correct condone one omission or extra. SC allow ACGJ for B1 only 2B1: Critical activites cao	
(e)	1M1ft: Correct calculation seen – all three numbers at least once. 1A1ft: Float correct >0	
(f)	1M1 = 1B: 3 1A1ft= 2B1ft:Correct calculation seen or ‘ 2< answer< 3	

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